You are being asked to design a control system using the PWM of an MC9S12. You are required to use high values for the PWMPERx register (≥100) to accomplish this task. Be sure your C code does not affect the function of any other PWM channels.

* Set up the MC9S12 to produce a 5 kHz PWM signal with a 10% duty cycle on Bit 0 of Port P.
Need to generate a 5 KHz signal so: $24x10^6/5x10^3 = 4800$

```
PWMCTL = 0x00;                                  //  Choose 8-bit mode
PWMCAE = 0x00;                                  //  Choose left-aligned
PWMPOL = 0xFF;                                  //  Choose high polarity
PWMCLK = PWMCLK | 0x01;                         // Clock mode 1 for Ch 0
PWMPRCLK = (PWMPRCLK & ~0x07) | 0x02;           // PCKA = 2
PWMPER0 = 200;                                  // Period for Ch 0 clock
PWMDTY0 = 20;                                   // 10% duty cycle
PWMSCLA = 3;                                    // Another prescaler
PWME = PWME | 0x01;                             // Enable PWM on Port P0
```

* Set up the MC9S12 to produce a 10 kHz PWM signal with a 20% duty cycle on Bit 2 of Port P.
Need to generate a 5 KHz signal so: $24x10^6/10x10^3 = 2400$

```
PWMCTL = 0x00;                                  //  Choose 8-bit mode
PWMCAE = 0x00;                                  //  Choose left-aligned
PWMPOL = 0xFF;                                  //  Choose high polarity
PWMCLK = PWMCLK | 0x04;                 // Clock mode 1 for Ch 2
PWMPRCLK = (PWMPRCLK & ~0x70) | 0x10;           // PCKB = 1
PWMPER2 = 200;                                  // Period for Ch 2 clock
PWMDTY2 = 40;                                   // 20% duty cycle
PWMSCLB = 3;                            // Another prescaler
PWME = PWME | 0x04;                     // Enable PWM on Port P2
```

A temperature sensor TC1047A is connected to the A/D converter of an MC9S12. The VRL is connected to 0 V, and the VRH is connected to +5V. The sensor is connected to PAD4. The TC1047A sensor has a linear response, and its voltage output is directly proportional to the measured temperature. The output voltage range for these devices is typically 100 mV at -40°C, and +1.75V at +125°C.

***** What is the value of ATD0DR4 (in hex) when the sensed temperature is 40° C?
The output voltage of the sensor at 40° C is VOUT= (10mV/°C)(Temperature°C) + 500mV=0.9 V
So the value of ATD0DR4 is ATD0DR4=0.9Vx(2^10-1)/5V = $184_{10} = B8_{16}$

***** After the set of eight conversions, the eight 16-bit result registers are as follows

ADR0	ADR1	ADR2	ADR3	ADR4	ADR5	ADR6	ADR7
0x004F	0x0071	0x0052	0x0012	0x0045	0x00C2	0x0023	0x0098

What is the temperature being measured by the TC1047A sensor.
The temperature is $0x45_{16} = 69_{10}$
V = 5V*(69)/(2^10-1) = 0.337
T =(0.337V – 0.5V)/10mV/°C = -16.27 °C

The MAX5381 is an 8-bit DAC with an IIC interface which can output an analog voltage from 0 to +4V . The spec sheet for the MAX5381shows that the maximum SCL frequency is 400 kHz. How would you set up the MC9S12 IIC hardware to have as high of a IIC speed as possible which meets these values?
You just need to make sure the frequency is 400 kHz or lower. 24 MHz/400 kHz = 60, so the clock divider needs to be 60 or larger. You can get a clock divider of 60 by writing an 0x45 to the IBFD register: IBFD = 0x45;